Telegraph Company (which had been encouraging experiments), had succeeded in effecting a balance, in 1873, on the Gibraltar-Lisbon cable by the use of the Wheatstone balance method and Varley's artificial line. Also, in a letter to the *Telegraphic Journal* for 1874, by Mr. B. Smith, of the Eastern Telegraph Company, we learn that he had succeeded in effecting a balance on one of the Company's cables between Malta and Alexandria in July, 1873, so that he could receive messages while sending a distance of 911 nautical miles. In September of the same year Mr. Smith also reported good success on the Malta-Gibraltar cable, a distance of 1,121 nautical miles. We are not aware, however, that these methods have been in practical working for any length of time.

In 1874 Mr. John Muirhead, of the firm of Messrs. Warden, Muirhead, and Clark, telegraph engineers, Westminster, took out a patent for a new form of condenser, or inductive-resistance, so made as to imitate a submarine cable, and ostensibly for the purpose of duplex telegraphy. The inductive resistance is formed by taking two strips of tinfoil and laying one over the other separated by an insulator. One strip forms the conducting circuit of the artificial line, the other forms the outer, or inductive coating, and is connected to earth. The current is passed through the conducting strip and exposed throughout its entire length to the induction of the other strip or sheet in the same way that the current in the conductor of the cable is subjected to the induction of the earth throughout its length. The principle of Muirhead's artificial line is shown in Fig. 7, where the arrows represent the local current passing along the conducting strip while being at the same time retarded by the induction of the other strip, or inducting plate, which is connected to earth.

This artificial, or model cable, can be made to have the same resistance, capacity, and even leakage, per knot, that the actual cable has, so that it can be made practically equal in its electrical properties to the actual cable. It may be employed either with the differential or Wheatstone balance methods. In either case the local current passes through the conducting strip to earth, experiencing the same resistance and retardation that the signalling current experiences in the cable. It therefore balances the signalling current in its effects on the instrument. Its advantage over Varley's "artificial line" consists in the closer equivalence to an actual cable that it admits of. Subsequent patents of Mr. Muirhead describe various adjustments to be used in connection with the artificial line for the purpose of refining upon the balance.

In July, 1875, this system, which is hitherto the most successful of all in submarine duplex, was first tried on the Marseilles-Bona (Algeria) cable, a length of 448 nautical miles. In the spring of this year it was established for permanent working on the Marseilles-Malta cables of the Eastern Company, a length of 826 nautical miles, and also on the Suez-Aden cable, a length of 1,461 nautical miles, but in an electrical sense, one of the longest of existing cables. These are the first practical successes in submarine duplex telegraphy, and they also prove the feasibility of working cables of any length by this advantageous method.

MUSEUM SPECIMENS FOR TEACHING PURPOSES[1]

II.

ARTICULATED or mounted skeletons are divided into two classes: 1. Natural; 2. Artificial. The two processes may, however, be more or less combined in certain cases.

Natural skeletons are not macerated. The bones are merely cleaned by the hand, assisted by scalpel, scissors, and brush; the subject being placed in water during the intervals of the operation, to get it free from blood, and to soften the parts removed. Everything having been taken away, except the bones and the ligaments which unite them, the skeleton is fixed in the required attitude by external supports, and allowed to dry. This process is commonly adopted with very small mammals, birds, reptiles, and especially fish. It has the advantage of involving less labour and skill in articulation, and of affording a trustworthy record of the number and relations of the bones, especially the vertebræ, about which, in an artificially articulated skeleton, unless prepared by very competent hands, there always may be doubt. On the other hand, such skeletons are far less useful for the study of the details of their structure, they not only cannot be taken to pieces, but the extremities of the bones are actually concealed by the dried ligaments. The latter, moreover, often become brittle with time; and in the case of the smaller specimens, will break unless handled with great care. In such cases it is often advisable to strengthen them with isinglass, or when more support is required, some strands of cotton-wool steeped in melted isinglass or glue make excellent artificial ligaments.

2. Artificial skeletons are those in which the bones have all been separated and completely cleaned by maceration, or one of the processes substituted for it, and then joined together again by wire. The reconstruction of such skeletons is technically called "articulating." To perform it properly some knowledge is required of osteology, so that the bones may be placed correctly, which of course is of the utmost importance, and also some mechanical skill in drilling the holes in the bones, and in adapting and fitting the wires and metal supports, and several instruments are required, not needed in the preparation of natural skeletons, such as drills, pliers, wire-cutters, files, &c.

The best wire is iron-tinned, which does not rust, and is now sold at most ironmongers. For very fine work, iron wire plated with silver, and for still more delicate operations, especially in fishes' skeletons, thin silver wire may be used. Copper wire is too soft and flexible for almost all articulating work, and is apt to give a green stain to bones which contain any grease, and so should be avoided. Brass tubing of various sizes is now extensively used in articulating, and for larger animals, iron supports, which will have to be made by the blacksmith specially for each subject.

However great the knowledge of the articulator, it is always best to take precautions before macerating an animal, that there should be no mistakes in arranging the bones properly, especially in the case of rare and little-known specimens. The skin and the greater part of the soft parts having been removed, and the bones roughly prepared as for a natural skeleton, should then be divided into several parts. The sternum with the costal cartilages should be removed by cutting through the latter at the junction with the ribs, and cleaned in water without macerating, and then allowed to dry in their natural form on a block of wood, cut to the requisite shape and size. If this part goes into the macerating vessel, the cartilages will be lost, and the thorax can then only be restored in an imperfect manner. The limbs should be separated, and if each is macerated in a separate vessel, much trouble will be saved in sorting the small bones of the feet. If there is any doubt about articulating them correctly, it is best to take them out before they have actually separated, and clean them off and articulate them at once, at all events drilling the holes for the wires while they are still in natural apposition. The vertebræ may be allowed to come apart and macerate together, as there is never any difficulty in placing them in their natural sequence. The hyoid bones should be sought for in the throat, and cleaned and preserved separately, and small sesamoid bones about the feet and behind the knee-joint in most animals, so commonly lost in museum specimens, should be looked for and preserved, as well as the rudimentary clavicles of the carnivora and the pelvic bones of the whales and porpoises. When the relations of any bone to another, especially of the sesamoids above spoken of, or the chevron bones under the caudal vertebræ, are likely to be lost in maceration, they should always be observed, and either notes or drawings made of them, or they should be marked with fine holes, made with an Archimedian drill (an essential instrument to the articulator). By making two holes on different bones opposite to one another before the bones are separated, or several holes arranged in patterns, most important records can be preserved, and such small holes do not damage the bones, as they can be filled up afterwards with putty, or frame-makers' composition.

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[1] Lecture at the Loan Collection of Scientific Apparatus, South Kensington, July 26, 1876, by Prof. W. H. Flower, F.R.S., Conservator of the Museum of the Royal College of Surgeons of England. Continued from p. 146.

The perfection of a skeleton, an object always to be aimed at, will greatly depend upon the attention paid to all the small precautions just named, and others which will suggest themselves in the course of the process.

In skeletons, as ordinarily articulated, the principal object seems to be to preserve the general appearance of the framework of the animal and to make the whole firm and strong, at the same time showing as little as possible of the supports necessary to hold it together. Every bone, even to the skull and lower jaw, is immovably fixed, and strong wires, or irons, according to its size, are made to traverse the interior of the limb bones, fixed into the stand below, and connected with the main support, which runs along the centre of the bodies of the vertebræ from head to tail.

Such skeletons are little better for the detailed study of osteology than are natural skeletons, and they are inferior, inasmuch as there is no guarantee against errors on the part of the articulator, unless he be of known knowledge and experience.

The improvements in articulating skeletons that I am about to bring before your notice were commenced about twelve years ago, and are mainly due to the ingenuity and skill of the veteran articulator to the Museum of the Royal College of Surgeons, my namesake, Mr. James Flower, who has successfully put into practice various ideas and suggestions which have occurred to me during the time of my conservatorship.

The object aimed at is to mount a skeleton which will give a perfect idea of the form and proportions of the animal and show the bones in their relative position, and at the same time allow every part of each bone to be separately examined. Any portion which is required for examination must be made capable of being removed without disturbing the rest of the skeleton. The skull, the lower jaw, the different vertebræ, the pelvis, the limb bones must be all separable.

Such a skeleton of course cannot be supported on its own limbs, like one of the old kind, as the bones of all the extremities may be removed one by one if necessary, leaving the trunk *in situ*. It will also be somewhat less firm and stable, and must be treated with care, as in fact a delicate and somewhat complicated instrument would be.

The details by which this principle is carried out vary greatly, and must be adapted to every different animal, and may probably be yet still further modified and improved. The illustration sent to the Exhibition is a very fair example. It is a skeleton of a scaly anteater or pangolin (No. 3,812). The two principal mechanical arrangements adopted are simple enough.

They are, first, the use of brass tubes, into which wires of corresponding size are made to slide. This is the best method of connecting two parts, which have to be separated at pleasure. When necessary the tubes and wires may be flattened to prevent them turning. The principal supports are made of tubes fixed into the wooden stand below, and into the upper end of which a short wire fixed in the bone to be supported slides. These tubes can readily be riveted to each other so as to make a branched support when required.

The second mechanical contrivance consists in the use of twisted or plaited wires as a means of movable connection between bones which need not be completely separated, but only bent upon each other as by a hinge. For instance, the principal bones of the limbs are connected by a strand of wires, twisted together like a rope, passing on one side of the joint. Each end is inserted in a hole drilled in the bone, and fixed by means of small wedges of wood or metal. These joints are so stiff as to remain in any position in which they are placed, and yet are perfectly flexible and durable. The vertebræ are connected, by being fixed by wires, on to a plaited band, passed along the inferior surface of their bodies, where nothing of importance is concealed by it. Since this skeleton was mounted it has, however, been found better in many cases to run the plaited wire through the canal, so that it is perfectly out of sight. Though neatness in the mountings of a skeleton is certainly a desideratum, it is better to have any number of external supports to the bones, than either to fix immovably or to mutilate them, as was often done in the old plan, in order to allow of the introduction of the concealed supports.

The ribs, sternum, and sternal ribs are usually mounted in one solid piece, separable from the vertebral column, so that the articular ends of all the ribs can be easily examined. In some cases it is found better to string the vertebræ upon a stiff rod, or several pieces of rods, connected by sliding joints, from which they can be removed in succession. In fact, as before said, the modifications of these processes are numerous, but they can best be appreciated by examining a few mounted specimens, and may be further developed by the suggestions of experience.

In addition to the complete mounted skeleton, museums will be expected to have separated portions of the bony structures exhibited in a manner that the student can study them. The skull especially must be treated in this way. For many years skulls of various animals have been prepared at Paris "*à la Beauchène*," and there are some good examples in the Exhibition contributed by Tramond, including an entire human skeleton (No. 3,913, also 3,915 and 3,918, skulls of man and turtle).[1]

All the bones are separated and fixed by brass bands and wires, at short intervals from each other, so as to allow of their complete form being examined.

The sliding joints formed of brass tubing will be found a great improvement in such specimens, as it allows the complete removal of any portion required for more particular examination. An example will be seen in the skull of a sheep (No. 3,819), contributed by Mr. E. T. Newton, of the Museum of Practical Geology.

A single bone is best mounted by driving a sharpened wire into its lower surface, which wire slides into a tube of corresponding diameter fixed in the wooden stand; in this way all the series of separate bones in the Museum of the College of Surgeons are mounted. The stands are made of turned wood, circular, polished, and black. All the brass work in them and the mounted skeletons is coated with a layer of black japan varnish.

I must not omit to mention a method of mounting skeletons devised and recommended by Prof. Huxley, the details of which have been developed by Mr. Newton from processes initiated at the College of Surgeons. There is an example in the Exhibition in the skeleton of a dog, No. 3904*a*. Each of the bones of the skeleton is mounted separately with wire and tubing, as in the single bone just spoken of, but they are arranged on a single flat board in definite order, the vertebræ in succession along the middle, and the limbs on each side, each bone being near its actual position of the body. Skeletons so prepared can be arranged one above the other in a cabinet, each board running on ledges in the sides of the cabinet like drawers. They are very convenient for study and demonstration, especially for advanced students; but they are not so suitable for public museums or for elementary teaching, as they convey no idea of the general appearance, form, and proportions of the animal from which they are prepared.

Certain portions of the skeleton, especially of the lower vertebrates, are never ossified, but remain permanently in a cartilaginous condition, and when dried, shrivel and contract into small shapeless masses. But it would be often desirable, in a dry skeleton, to keep them if possible, if only to preserve the positions and relations of the surrounding bones. For instance, the axial portions of the skeleton of many fishes' heads are entirely cartilaginous, and so are the carpal bones of the crocodile. Such parts ought to be modelled either in soft wood or in the composition of whiting, resin, and linseed oil used by the picture-frame-makers, which is soft and plastic when recently made, but sets to an almost stony hardness. Specimens of the application of such modelling may be seen in the Museum of the College of Surgeons.

Besides the skin, and the skeleton, many other parts of the body are frequently preserved in a dry state in museums. When bottles and spirits were very dear this method was much more attended to than at present, and it was extensively used for injected preparations, showing the course of the blood-vessels, and even dissections of muscles and nerves, as well as for the hollow viscera, such as the stomach, cæcum, &c., which were inflated, dried, and then varnished. There are many objections to such preparations. All soft and fleshy parts, when dried, contract so much as to give little idea of their appearance in the recent state, and in doing so disturb the relations of the parts in contact with them. Inflated organs, which look very well for a time, are apt to collapse, and they are all liable to decay and to perish from the attacks of insects. To guard against this it is absolutely necessary that the preparations should be thoroughly soaked in alcoholic solution of corrosive sublimate, or some other such poison, before the drying process commences. In Italy, especially in the Museum of Comparative Anatomy at Pisa, I have seen beautiful and very instructive specimens of viscera preserved in a dried state, and it is to be regretted that none have found their way into this Exhibition, as they might have stimulated us to endeavour to do something to improve the art, which in most of our anatomical museums is now almost obsolete.

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[1] I should also call attention to a beautiful human skeleton by the same exhibitor, for the purpose of practising dislocation (No. 3,914), in which the principal bones are connected by coiled spring wire. This method has long been used on a partial scale, as for attaching the lower jaw to the skull, but is not so convenient as the one described above, as the elasticity of the spring is always an impediment to the free examination of the bones.

The methods of preserving the hard parts of invertebrate animals, such as insects, molluscs, and coral animals, in a dry state, are so generally understood, and so fully described in many special treatises,[1] that there is no occasion to detain you with them at present. The best illustration in the present collection of this branch of the subject is the very valuable and instructive preparation of the Exoskeleton of the common lobster (No. 3904 *e*) prepared by Mr. E. T. Newton, and exhibited by Prof. Huxley, which is a model of a class of preparations which might be largely employed in teaching zoology. I may also call attention to a small series of preparations contributed by Prof. H. Landois, of Münster (No. 3878), which purport to show something of the life history and habits of several species of insects, an idea which might be more fully carried out in biological museums, and to the typical collections of the shells of molluscs exhibited by Mr. R. Damon (Nos. 3808 to 3811).

(*To be continued.*)

OUR ASTRONOMICAL COLUMN

THE NEW STAR IN CYGNUS.—On the evening of December 13 this star, as regards brightness, was about midway between 75 Cygni and Bessel's star, Weisse XXI. 1004, the *Durchmusterung* magnitudes of which are 5·2 and 6·5 respectively, giving for the new star a magnitude of about 5·8 to 6·0, as stated last week. On December 20 it was not more than 0·25m. brighter than Bessel's star, indeed at moments it was difficult to say which was the brighter of the two; its present rate of decline is therefore slower than during the first ten days after the discovery. In the foggy sky of December 20, there was a yellowish tinge in its light, not perceptible in Bessel's star. A further careful search through our star-catalogues has failed to reveal any previous observation of a star in this position. It falls in one of the two zones, the re-observation of which has been undertaken at Bonn.

THE BINARY STAR 6*p* ERIDANI.—It may be hoped that some one of our southern observers is putting upon record measures of this double star, of which, so far as we know, none have been published since those of Mr. Eyre B. Powell at Madras, at the beginning of 1861, when the angle of position was 253°, and the distance 4″·9. Altering the node in Capt. Jacob's second orbit to 109° 40′, and assuming the peri-astron passage to have occurred 1817·64, with a period of revolution of 117·48 years, the measures from 1835 to 1861 are very closely represented, without change in inclination, distance of peri-astron from node, or semi-axis major. Dunlop's measures in December, 1825, which are of doubtful interpretation, would, with Jacob's correction, differ 6½° from the computed angle. Later measures than those of 1861 are required for a decision on the true form of orbit. α Centauri and *h* 5114 (R.A. 19h. 17m. 50s., N.P.D. 144° 34′ for 1876) are equally to be recommended to the close attention of the southern astronomer.

When a systematic remeasurement of the double stars of Sir John Herschel's Cape catalogue, which are out of reach in these latitudes, is undertaken (and we know of no more desirable or more interesting work in the miscellaneous astronomy of the other hemisphere), a large accession to the list of binaries may be anticipated. Perhaps M. O. Struve has not—in 24 Comæ Berenicis—detected the most rapid of the revolving double stars, which it may remain for a southern observer to bring to light.

PERIODICAL COMETS IN 1877.—Of the known comets of short period only one—that of D'Arrest—has been predicted for the ensuing year, though if the elements of De Vico's comet of 1844 have not undergone a violent change since that appearance, it may be expected to be in perihelion also within the next twelvemonths.

D'Arrest's comet will arrive at its least distance from the sun on May 10, but will not be nearest to the earth until October; its positions when observations should be most feasible, are not favourable for observers in the northern hemisphere. M. Leveau's elaborate ephemeris affords every possible assistance towards its detection. At its last visit in 1870 this comet was excessively faint, and was not observed at more than four or five of the numerous European Observatories.

Surely there must soon be an end of the dearth of discoveries of new comets which has prevailed since the beginning of December, 1874.

ANCIENT SOLAR ECLIPSES.—In NATURE (vol. xv., p. 116), Sir George Airy notes a difference in the path of the shadow in the total eclipse of B.C. 763, June 14, given in this column (p. 65) from that defined by a direct calculation from Hansen's Tables. In explanation of this difference it should be stated that our elements of the eclipse of B.C. 763, as also (with one exception) for other eclipses to which we have from time to time referred, are obtained by the use of Damoiseau's Lunar Tables of 1824, with the main arguments, and one or two of the principal equations adapted to the elements resulting from Sir George Airy's laborious discussion of the observations of the moon at the Royal Observatory, Greenwich, from 1750 to 1830, combined with M. Leverrier's Solar Tables, and the introduction of Hansen's last values of the terms in longitude, anomaly and node depending on the square of centuries.

METEOROLOGICAL NOTES

THE STORM OF MARCH 12, 1876.—We turned with considerable interest to the account of this storm, which passed over the south of England on March 12, as published in the *Journal* of the English Meteorological Society for July. The interest was all the greater, seeing that the account was drawn up, at the request of the Council of that Society, by Mr. Scott, assisted by Messrs. Gaster and Whipple, that descriptions of the same storm had been previously published by Prof. Quetelet, Dr. Neumayer, and the late M. C. Sainte-Claire Deville, and that another paper on the same subject was intimated by Dr. Buys Ballot. The widespread interest which this storm has called forth is seen at once on looking at the nine weather maps and tables of Mr. Scott's paper, which show it to be one of the most remarkable storms of recent years, whether regard be paid to the rapid rate of its propagation eastwards, estimated by Dr. Neumayer at seventy-seven miles per hour over part of its course; to the rate of the barometric fluctuation, almost unprecedented in these islands, the bar meter at Kew having risen 0·407 inch during the two hour from 2 to 4 P.M.; or to the violent contrasts of temperature and weather on the two sides of the storm at comparatively short distances apart. To illustrate the subject with greater fulness a woodcut is given showing the automatic registrations of the different meteorological instruments at Kew, and tables of pressure and temperature for every ten minutes during the most interesting phase of the storm. To these curves a noteworthy and novel feature is added in the form of a curve showing the electrical changes from positive to negative, and *vice versâ*, at the time. The *hourly readings of their self-recording instruments* for March were moreover published shortly after by the Meteorological Office. On turning to these two barometric records taken from the same instrument at Kew, referring to the same time, and published by the same authorities, and comparing them together, we meet with nothing but confusion. Of the whole of the eleven instances on which readings are printed in the two records for the same instants of time, no two agree, the eleven differences being in order, + 0·006, – 0·024, – 0·008,

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[1] The most recent being "Notes on Collecting and Preserving Natural History Objects," edited by J. E. Taylor, Ph.D., and published by Hardwicke and Bogue, London, 1876.